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Planet Longitudes

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STEM Earth Central 2007

Planet Longitudes

Star light, star bright
First star I see tonight
Wish I may, wish I might
Have the wish I wish tonight

Objectives:

- To apply the concept of Longitude to the location of planets in their orbits.
- To predict what planets can be seen in the night sky on any date.

Stars are so far from Earth and so far apart that, even though they actually are moving, their arrangements in constellations do not appear to change from one night to the next. However, ancient astronomers noticed bright objects in the night sky that seemed to be "wandering stars". They appeared to change their position relative to "other stars" from one night to the next and sometimes seemed to reverse their direction. They named the wandering stars; Mercury, Venus, Mars, Jupiter, and Saturn. It was the apparent backward or retrograde motion of the "wandering stars" that eventually became the essential proof that planets move in heliocentric orbits around the sun.

Venus can sometimes be seen either during the early evening or very early morning hours and appears to have a silvery glow. The first "star" that you sometimes see at night may actually be Venus. Mercury can also be a morning or evening "star" but its position in the sky changes much more rapidly than does the position of Venus. Mars or Jupiter can sometimes be seen as the evening sky grows dark. Mars has a reddish appearance. Jupiter is quite majestic and changes its position in the sky quite slowly, as does Saturn, which is much harder to distinguish from actual stars.

Question 1: How might the appearances of the "wandering stars" have resulted in their mythology?

A. Orbit Longitudes

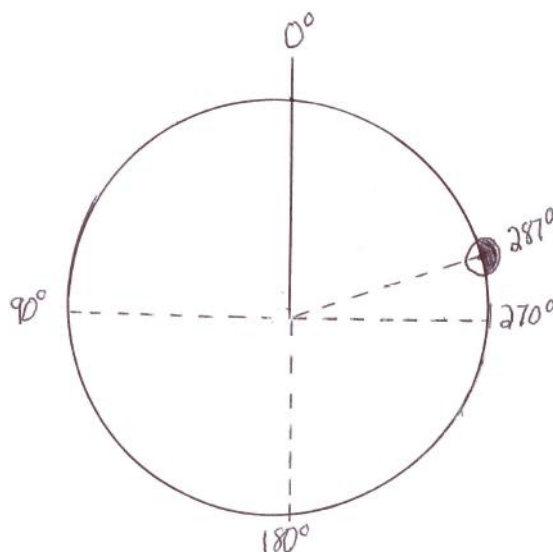
Astronomers, including the renowned Tycho Brahe, collected data which eventually led to an understanding of the movements of the wandering stars that are now called planets. It was Johannes Kepler who analyzed Tycho Brahe's data and developed three laws that mathematically describe the orbits and movements of planets.

Eventually, a system of Longitude was developed to describe the position of planets in their orbits. The system of planet Longitudes is based on the establishment of an imaginary and arbitrary "Prime Meridian" for the solar system.

The figure shown at the top of Page 2 illustrates how the concept of Longitude applies to the positions of a planet in an orbit. The circle represents an orbit of a planet. The straight line is the "Prime Meridian" of the solar system.

When viewed from a position "above" Earth's Northern Hemisphere, planets move in a counterclockwise direction as they orbit the sun. In the moment that a planet crosses the "Prime Meridian", its longitude is 0° . As the planet continues to orbit the sun, its Longitude increases to a maximum of 360° when it again reaches the imaginary "Prime Meridian" of the solar system.

Important Note: The orbits of planets are actually slightly elliptical rather than circular.



Earth's Orbit Longitude on a Fall Equinox = 0°

The following are approximate Longitudes for Earth.

Winter Solstice = approximately 90°

Spring Equinox = approximately 180°

Summer Solstice = approximately 270°

Question 2: What are some similarities and differences between planet Longitudes and the system of Longitude used to map Earth's surface?

B. Calculate Planet Longitudes

Step 2: Use the Planetary Heliocentric Longitudes Table on Page 4 to estimate or calculate and then record the planet Longitudes for the planets listed. Do this for today's date and for a future date in 2007. You will probably need to interpolate between data values listed on the Heliocentric Longitude Table.

Planet	Longitude #1	Longitude #2
	Date / /07	Date / /07
Mercury		
Venus		
Earth		
Mars		
Jupiter		
Saturn		

C. Place Your Planets

In order to place planets in locations on a map of the solar system for today's date and for a future date you need to:

Step 1: Obtain or draw a map of the orbits of Earth and the orbits of the "wandering stars" (the five planets visible from Earth without the help of a telescope).

Step 2: Place a small dot in each planet's orbit for its position today. Imagine that you are in the vicinity of the North Star and looking "down" onto Earth's Northern Hemisphere. From that perspective, the planets move in a counter-clockwise direction around the sun as time passes.

Step 3: Place a small dot in each planet's orbit for its position at a later date this year. Place small triangles around each of the planet's positions for the later date this year.

D Make a Prediction

You will now be able to use the diagram of planet positions to make some interesting astronomical predictions.

1. Draw a small circle around Earth at each marked location of Earth in its orbit.
2. On each circle, darken the half that faces away from the sun to simulate nighttime on Earth.
3. Imagine that you are standing on the circle that represents Earth as it rotate from evening to midnight to early morning.

Question 4: Which planets will you probably be able to see tonight? (if the sky is clear)

- in the early evening sky?
- in the middle of night?
- in the early morning sky tomorrow morning ?

Question 5: Which planets will you probably be able to see on the second date? (if the sky is clear)

- in the early evening sky?
- in the middle of night?
- in the early morning sky the next morning ?

E. Test Your Predictions

You can test your predictions either by comparing them with information provided in the Sky Gazer's Almanac published each January by the publishers of Sky and Telescope magazine.

You can also go outside tonight and on the second date and test your prediction by observing the night sky.

Question 6: How would knowledge of Planet Longitudes be helpful in planning a mission from Earth to Mars?

PLANETARY HELIOCENTRIC LONGITUDES 2007

Source: http://www.as.wvu.edu/~planet/planetary_heliocentric_longitude_2007.htm

The heliocentric longitude of a planet is the angle between the vernal equinox and the planet, as seen from the Sun. It is measured in the ecliptic plane, in the direction of the orbital motion of the planet (counterclockwise as viewed from the north side of the ecliptic plane). Knowing the heliocentric longitudes and the distances of the planets from the Sun, one can construct a diagram or model showing the relative orientations of the Sun and planets on any date.

<u>Universal Time</u>	<u>Mercury</u>	<u>Venus</u>	<u>Earth</u>	<u>Mars</u>	<u>Jupiter</u>	<u>Saturn</u>	<u>Uranus</u>	<u>Neptune</u>	<u>Pluto</u>
Jan. 1.0	269°	318°	100°	245°	243°	140°	344°	319°	267°
Feb. 1.0	025°	007°	132°	261°	245°	141°	344°	319°	267°
Mar. 1.0	181°	052°	160°	277°	247°	142°	345°	320°	267°
Apr. 1.0	275°	102°	191°	296°	250°	143°	345°	320°	267°
May 1.0	031°	151°	220°	315°	252°	145°	345°	320°	267°
June 1.0	196°	201°	250°	334°	255°	146°	346°	320°	268°
July 1.0	284°	249°	279°	353°	257°	147°	346°	320°	268°
Aug. 1.0	055°	298°	309°	012°	259°	148°	346°	321°	268°
Sept. 1.0	209°	347°	338°	031°	262°	149°	347°	321°	268°
Oct. 1.0	296°	035°	008°	048°	264°	150°	347°	321°	268°
Nov. 1.0	080°	085°	038°	065°	267°	151°	347°	321°	268°
Dec. 1.0	219°	133°	069°	081°	269°	152°	348°	321°	269°
Jan. 1.0	309°	184°	100°	096°	272°	153°	348°	321°	269°